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THE SIZE AND SEASONAL DISTRIBUTION OF THE SIBLING SPECIES *TABANUS NIGROVITTATUS* AND *TABANUS CONTERMINUS* IN NEW JERSEY (DIPTERA: TABANIDAE)[1]

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Abstract.—The salt marsh greenhead flies in New Jersey comprise a pair of cryptic species, *T. nigrovittatus* and *T. conterminus*, that can be discriminated completely with protein electrophoresis. Although they overlap in size, *T. conterminus* is somewhat larger on the average, but it is far less abundant throughout the state and during the summer breeding season. Some aspects of the population dynamics of these species are discussed in reference to potential control strategies.

The mingling of two or more closely related species that cannot be distinguished by conventional taxonomic techniques provides a special problem for pest management programs. Attempts at biological or chemical control may fail, or even exacerbate a problem, because of the inherent differences in breeding seasons, life history dynamics, and susceptibilities among the members of a cryptic species complex. We recently recognized a cryptic species pair in the *Tabanus nigrovittatus* (*sensu lato*) Macquart complex in New Jersey. Electrophoretic studies revealed the presence of two reproductively isolated populations in most of our samples (Jacobson et al., 1981). Although the two species exhibit somewhat different but overlapping size distributions, they are easily separated by allozyme phenotypes encoded by several gene loci. This work corroborated earlier suspicions that *T. nigrovittatus* might represent a cryptic species complex (Freeman, 1962; Freeman and Hansens, 1972). The larger of the two flies (Group II of Jacobson et al., 1981) is *T. conterminus* Walker (Burger et al., 1985). The smaller species is *T. nigrovittatus* (*sensu stricto*).

The seasonal distribution of the *T. nigrovittatus* complex extends from mid-June to mid-September in New Jersey, with the greatest abundance in July (Hansens, 1952). The purpose of this study was to delineate seasonal activity patterns and size distributions of adult *T. nigrovittatus* and *T. conterminus*.

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Table 1. The mean body length of *T. nigrovittatus* and *T. conterminus* from four sites in New Jersey.[1]

Site	Mean Body Length ± SD	
	T. nigrovittatus	*T. conterminus*
Island Beach State Park	10.69a* ± 0.62 (499)	13.44a (1)
Cedarville	10.62ab ± 0.68 (649)	12.89a ± 0.60 (8)
Leeds Point	10.56b ± 0.69 (477)	12.80a ± 0.76 (55)
Stone Harbor	10.42c ± 0.68 (560)	12.48a ± 0.73 (51)

[1] Sample size is in parentheses.
* Means with the same letter in vertical columns do not differ significantly at $P = 0.05$, by Duncan's multiple range test.

Materials and Methods

Samples of *T. nigrovittatus* and *T. conterminus* were collected at weekly intervals from the end of June to the end of August, 1980. Female flies were collected from box traps (Hansens and Race, 1979) located on salt marshes at four sites in New Jersey: Cedarville, Stone Harbor, Leeds Point and Island Beach State Park. The flies were transported to the laboratory in cloth cages and a sample of 40–80 living flies was frozen and stored at −50°C prior to electrophoretic analysis.

The flies were thawed and their total lengths measured. The carcasses were crudely homogenized in 0.2 ml of a pH 7.0 buffered grinding solution (Vrijenhoek, 1978). Homogenates were centrifuged for 1 min. at 2500 g and the supernatant fluid was subjected to electrophoresis.

The horizontal electrophoretic procedure was essential as described by Buroker et al. (1975). The gels, 12% by weight, were made of a 4:1 mixture of Sigma Starch (Sigma Chemical Co., St. Louis, MO) and Electrostarch (Electrostarch Co., Madison, WI). Buffer used in the gel and electrode was n-(3-aminopropyl)-morpholine citrate at pH 6.0 (Clayton and Tretiak, 1972). Histochemical stains were modified after those of Shaw and Prasad (1970).

The identification of species was based on 6-phosphogluconate dehydrogenase and glyceraldehyde-3-phosphate dehydrogenase. The alleles encoding both enzymes are diagnostic for *T. nigrovittatus* and *T. conterminus* (Jacobson et al., 1981). No heterozygous individuals have ever been observed at either locus.

Results

All of the flies in five samples from Leeds Point were measured and examined electrophoretically. In total, 18 *T. conterminus* and 274 *T. nigrovittatus* were found. The mean body length of the *T. conterminus* was 12.78 ± 0.79 mm (range: 11.58–14.01 mm). The mean length of the *T. nigrovittatus* was 10.47 ± 0.71 mm (range: 8.44–12.44 mm). Flies of less than 10.6 mm were well outside the 99% confidence limits of the *T. conterminus* distribution. We used the 10.6 mm size criterion to examine the data of Jacobson et al. (1981: fig. 2), and found that it

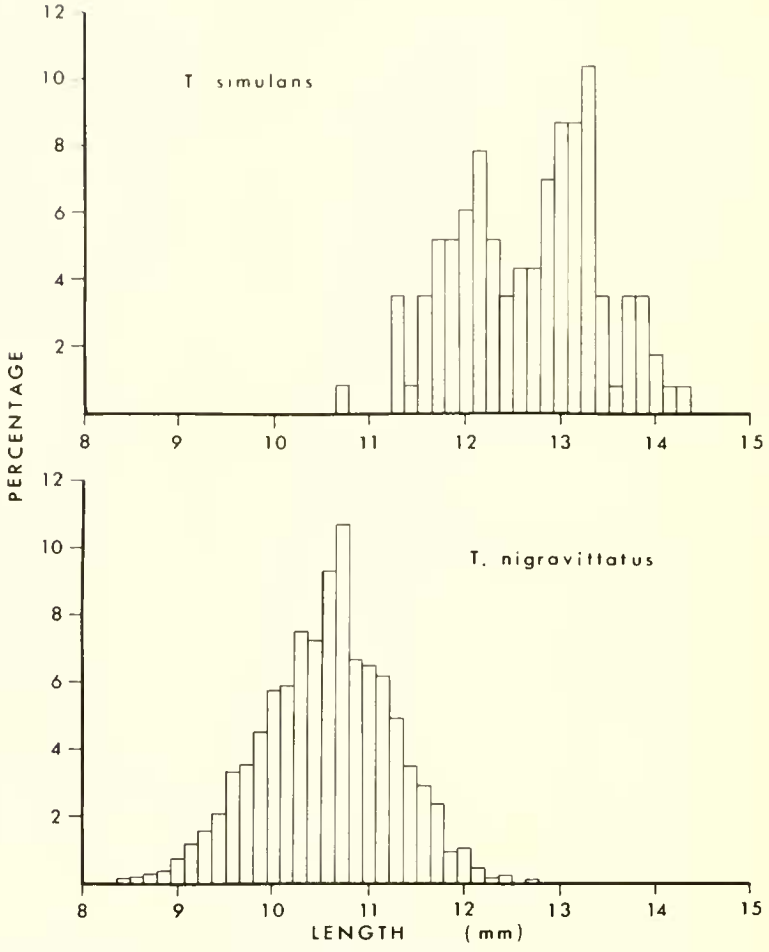

Fig. 1. Size distribution of *T. nigrovittatus* (n = 2185) and *T. conterminus* (n = 115).

resulted in no misidentifications of the 53 *T. conterminus* identified electrophoretically. Thus, for the remainder of the samples only flies over 10.6 mm were identified by electrophoresis since smaller flies were invariably *T. nigrovittatus*. This convenience reduced by about one-half the number of the flies subjected to electrophoresis, with considerable savings in time and expensive materials.

The mean body length of *T. nigrovittatus* collected at Stone Harbor was significantly shorter than *T. nigrovittatus* collected from Island Beach State Park, Cedarville, and Leeds Point (Table 1). The reason for this difference is unknown. There was, however, no significant difference in mean body length at the four sites for *T. conterminus* (Table 1). With all four populations combined, the mean length was 10.57 ± 0.68 mm for *T. nigrovittatus* and 12.67 ± 0.75 mm for *T. conterminus*. The combined size distributions for the two species is shown in Fig. 1. These measurements are not significantly different from those reported by Jacobson et al. (1981). They reported mean lengths of 10.5 and 12.8 mm for *T. nigrovittatus* and *T. conterminus* respectively.

Table 2. Total body length of *T. nigrovittatus* collected from four sites in New Jersey.

Date	N	Mean
20 June	181	10.792a*
27 June	204	10.712ab
2 July	46	10.725ab
9 July	202	10.569b
18 July	185	10.650b
25 July	267	10.571b
1 August	309	10.654b
6 August	237	10.618b
13 August	127	10.516b
20 August	193	10.307c
26 August	234	10.306c

* Means with the same letter in vertical columns do not differ significantly at $P = 0.05$, by Duncan's multiple range test.

The total body length of *T. nigrovittatus* decreased over the summer. The mean lengths of flies collected in the last two weeks of August were significantly shorter than the lengths of those collected earlier in the season (Table 2). This trend was not observed in *T. conterminus* perhaps because the sample size was quite small.

Discussion

Based on box trap collections, *T. nigrovittatus* is the dominant species in the *nigrovittatus* species complex in New Jersey. It constituted greater than 95 percent of the total number of flies in collections from Cedarville and Island Beach State Park (Table 3). *T. conterminus* was relatively more abundant at Leeds Point and Stone Harbor although it never numerically dominated *T. nigrovittatus* at any locality. Leeds Point and Stone Harbor marshes are both extensively ditched for mosquito control, whereas Cedarville and Island Beach marshes are relatively undisturbed. However, the influence of marsh ditching on these two species of tabanids is unclear. Freeman and Hansens (1972) reported that the larvae of *T. conterminus* (referred to as *T. species 3*) were most often found in the higher ground near drainage ditches, but Rockel and Hansens (1970) found that this species was uniformly distributed on the salt marsh. In order to resolve this dilemma, large samples of larval tabanids must be collected from the salt marshes and at the same time information on soil conditions (pH, moisture, salinity, etc.) and vegetation must be obtained. It is likely that electrophoretic techniques can also be developed to corroborate the identification of the larval stages of these species. The relative seasonal abundance of the two species differs considerably (Table 3). Over all the sites, *T. conterminus* reached its peak of abundance in mid-July and declined rapidly in August. This peak is most evident at Stone Harbor and Leeds Point where *T. conterminus* constituted maxima of 30.2 and 41.4 percent of the adult flies, respectively, on July 18. Jacobson et al. (1981) reported that 30 percent of their sample was *T. conterminus*. The samples were all collected in July (Jacobson, personal communication).

The rapid decline in the proportion of *T. conterminus* after mid-July corresponds with the overall decline in the population density of tabanids on the New Jersey salt marshes (Hansens, 1952). It is apparent from the present data that *T.*

Table 3. Percentage of *T. conterminus* in box trap collections in 1980.[1]

Week Ending	Collection Site			
	Cedarville	Stone Harbor	Leeds Point	Island Beach State Park
June 20	3.7%	0.0	0.0	—
	(54)	(72)	(58)	
June 27	5.0	12.5	13.5	0.0
	(60)	(48)	(52)	(60)
July 4	2.1	—	—	—
	(47)			
July 11	2.0	13.0	15.8	0.0
	(51)	(54)	(57)	(59)
July 18	1.7	30.2	41.4	0.0
	(58)	(43)	(58)	(65)
July 25	0.0	22.3	13.9	1.4
	(64)	(94)	(72)	(69)
August 1	0.0	2.8	1.3	0.0
	(83)	(71)	(77)	(82)
August 8	0.0	3.4	5.7	0.0
	(76)	(58)	(53)	(56)
August 15	0.0	0.0	—	—
	(66)	(61)		
August 22	0.0	0.0	0.0	0.0
	(43)	(39)	(56)	(54)
August 29	0.0	0.0	2.0	0.0
	(58)	(71)	(49)	(58)

[1] Sample size is indicated in parentheses.

nigrovittatus declines more slowly than *T. conterminus*. Perhaps *T. nigrovittatus* has greater longevity during this period. Alternatively, it may have a prolonged period of adult emergence compared to *T. conterminus*. Hansens (1952) suggested that *T. nigrovittatus* (*sensu lato*) might be partially bivoltine in New Jersey. The reduction in body size that we observed during the last two weeks in August supports this hypothesis. The tight clustering of emergence in *T. conterminus* indicates that it is univoltine.

Coastal tabanids have an important economic impact on both the recreational and agricultural industries in New Jersey (Hansens, 1980). The relative nuisance levels contributed by *T. nigrovittatus* and *T. conterminus* is not known at this time. Differences in the nuisance levels may be affected by the degree to which they penetrate inland, their persistence in hostseeking, the severity of biting, and the breadth of their host range. The absolute numbers of these tabanids coming to box traps, which we equate with population density, are greatest in mid-July (Hansens, 1952). *T. conterminus* makes its greatest numerical contribution in mid-July. Whether it adds to the number of tabanids and the severity of the problem during this month, or if it simply displaces a similar number of *T. nigrovittatus* is not known. Control programs designed to eliminate flying adults during this peak should affect *T. conterminus* more severely than *T. nigrovittatus* since oviposition in *T. conterminus* is restricted to this narrower time period.

Acknowledgments

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